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'Liquid Sunshine' Project Produce Gasoline Precursor from Carbon and Water

A new idea for using concentrated solar energy to produce gasoline precursors from carbon dioxide and water is being developed at Sandia National Laboratories.

Ellen Stechel, manager of Sandia's Fuels and Energy Transitions department, and colleagues envisage a marriage of future hydrogen and biomass economies that preserves the attractive components of each, providing an alternative to carbon sequestration by using rather than burying the carbon dioxide from industrial waste. Their plan is to integrate carbon capture, solar, and chemical processing technologies in such a way that the full system will efficiently and directly capture and convert the same resources that make up biomass – energy, carbon dioxide and water – into infrastructure-compatible liquid fuels.

"The team aims to achieve 10 percent efficiency in converting sunlight to chemical energy and use no fossil fuels," Stechel says.

The Sandia process uses solar energy to coax carbon dioxide into forming methanol as a critical intermediate in the production of gasoline. Carbon dioxide is captured and separated from industrial waste then reduced to carbon monoxide in Sandia's new "CR5" two-step solar reactor invented by Rich Diver and Jim Miller.[*] The carbon monoxide and water are then converted to methanol in a single-step or two-step process by adapting existing commercialized processes. Finally, the methanol is converted to gasoline through commercially available technologies.

"Analysis of the S2P process suggests that we could approach 10 percent efficiency for conversion of solar energy into chemical energy," Stechel says. "This means it could truly be a game-changer and potentially provide an avenue to disruptive solar technologies. In other words, it would permit greater utilization of the one truly sustainable energy source, sunshine, without needing to make radical changes to the distribution or end-use infrastructure, which is heavily reliant on liquid hydrocarbon fuels."

Stechel points out that the bulk of point source carbon dioxide comes from coal-burning power plants and cement plants. "That's where we are figuring we would get the carbon dioxide from initially," she says.

While Sandia researchers do not expect their concept could come on stream in the short term, they are optimistic that it can be brought to reality in the medium term, smoothing the transitional path to a hydrogen economy. They hope to establish a collaborative development program with industry, moving to prototype stage in 3-5 years, followed by field testing and scale-up engineering before moving to the market.

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[*] The CR5 concept appears as paper No. ISEC2006-99147, "Solar Thermochemical Ferrite-Cycle Heat Engines," in the Proceedings of ISEC2006: ASME International Solar Energy Conference, July 8-13, 2006, held at Denver, Colorado.